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THE GEHL LABORATORY RICE-SCOURING DEVICE

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THE PROBLEM

When definite Federal standards (grades) for rice, were established the rice industry needed a simple and efficient method of scouring or milling small samples of rough rice and brown rice so that the quality and general appearance, as it would appear after commercial milling, might be more accurately determined. This is particularly true in the case of samples of doubtful quality. When human judgment alone is used in determining the degree of discoloration and the quantity of inferior kernels that are present in rough or brown rice there is often a difference of opinion as to what the general appearance and the quality of the rice will be after commercial milling.

The bran coat that remains on the kernels after the hull has been removed is normally of a deep brown color, but it often varies in thickness or texture and in shade of color. The bran coat may be discolored as the result of surface damage that does not extend into the kernels. Sound kernels on which the bran coat is discolored or heavy in texture may have a dark or damaged appearance even though the kernel may be white or creamy in color, which is the color requirement for the top grade in each class of milled rice. On the other hand, kernels on which the bran coat is of light texture and of a light shade may themselves be somewhat stained.

THE DEVICE MEETS THE PROBLEM

The Gehl laboratory rice-scouring device mechanically and efficiently removes the bran from brown rice. It may also be used to remove the hulls and bran from rough rice provided the rough rice is dry and is of good milling quality. By scouring the brown or rough rice the color and general appearance of the kernels are revealed, the freedom from damage or the extent and nature of the damaged condition of the individual kernels become evident, and a more accurate inspection is made possible for the product becomes comparable in appearance to commercially milled rice. Accurate determinations as to soundness, general appearance, and quality are essential for efficient marketing of rough and brown rice. (Fig. 1.)

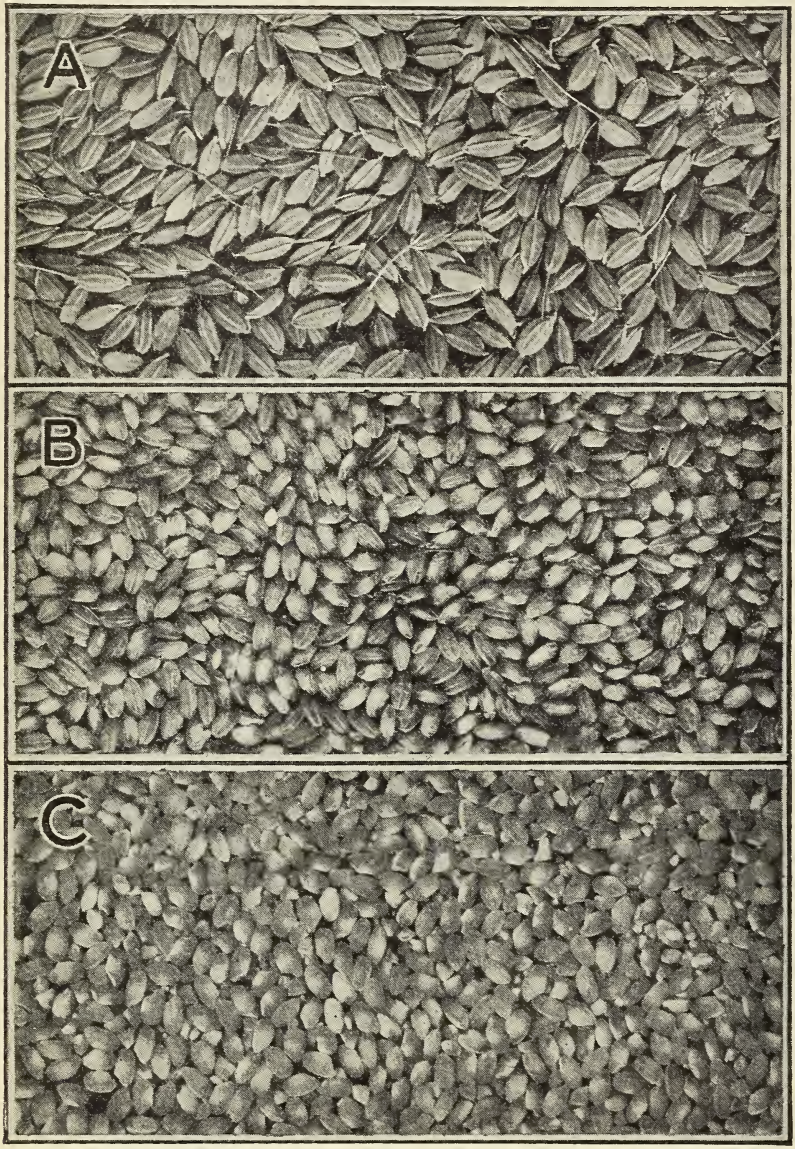

FIGURE 1.—Shelled and scoured portions obtained from the same lot of rough rice: A, Original rough rice; B, rice after shelling with a Smith shelling device; C, rice after scouring with the Gehl laboratory rice-scouring device

The device was developed to meet the need of Federal and State rice graders (inspectors), rough and brown rice dealers, rice millers, and sales managers and graders of rice-selling organizations for making a quick and accurate determination of the quality of lots of rice based on small samples of rough and brown rice. In inspecting and grading rough rice, in accordance with the provisions of the Federal standards (grades), the determination of discolored and damaged kernels were once made upon the brown rice obtained by hand shelling; more recently the Smith shelling device has been used for shelling the rice.[1]

Several agencies are finding the laboratory scouring device of help in connection with their work. State rice-inspection departments in California and in the Southern States are using it to assist in making determinations of discolored and damaged and chalky kernels in connection with the official inspection and grading of brown rice and of rough rice after the hulls have been removed with the Smith shelling device. Federal supervision offices of rice grading use it to assist in supervising the work of the State rice graders (inspectors). Sales managers of rice growers' associations use it to determine and to demonstrate the quality of the rough rice they sell for the account of the association members. Several rice milling companies use it for testing the rough and brown rice that they buy, mill, and sell. It is used in mill control work for testing the quality of rough rice lots of doubtful appearance before blending these together with other lots for milling.

A public service patent covering the device has been applied for. Under the terms of such a patent, if granted, anyone in the United States will be free to manufacture or use the device without paying a royalty.

DESCRIPTION OF DEVICE

In principle the Gehl laboratory rice-scouring device is simple. It consists of a mortar and a mechanically operated pestle. The mortar and pestle may be made of glass or any other hard substance that will not readily wear nor discolor the rice. When the device is in operation, the pestle moves vertically up and down in the mortar. The pestle plunger rods, which are attached by connecting rods to crank disks, are operated by an electric motor by means of a suitable drive mechanism so connected that when the power is applied the pestles operate at the required speed. (Figs. 2 and 3.)

In operation, a given quantity of rice mixed with a given quantity of sharp sand for certain tests, or without sand for other tests, is placed in the mortar. The motor is started, causing the pestle to move up and down in the rice or in the mixture of sand and rice, as the case may be. The action of the pestle on the rice, or on the mixture, causes the rice to move in the mortar and as it moves the individual kernels are forced against each other or against the sharp sand and the bran is gradually scoured off. The sample may be scoured for a prescribed period, or the operator may stop the scouring as soon as the rice has been sufficiently milled to suit his purpose.

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[1] SMITH, W. D. IMPROVED APPARATUS AND METHOD FOR MAKING "SHELLINGS" FOR ROUGH RICE. U. S. Dept. Agr. Circ. 48, 19 p., illus. 1928.

HOW TO MAKE A SCOURING

CORRECT SAMPLING ESSENTIAL

It is essential for accurate results that the sample of rice to be scoured be truly representative of the lot from which it was drawn. The recommended method for obtaining a correct sample from both sacked and bulk rice is described in United States Department of Agriculture Handbook of Official Standards for Milled Rice, Brown Rice, and Rough Rice. To obtain a representative portion from a larger sample it is recommended that a Boerner sampler[2] be used.

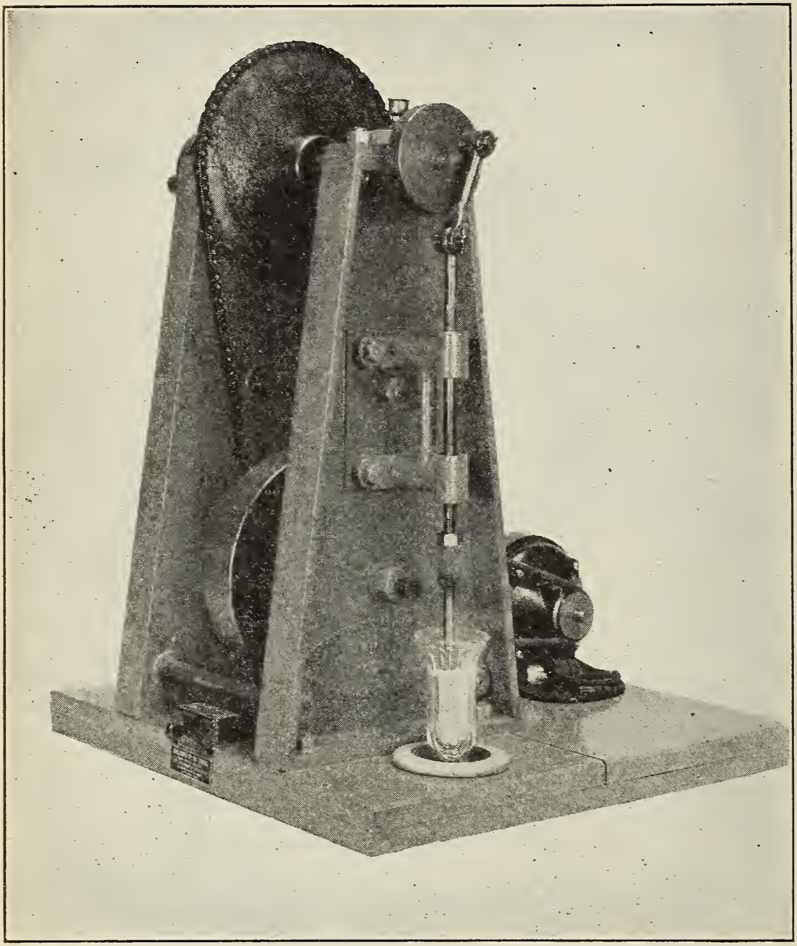

FIGURE 2.—Gehl laboratory rice-scouring device (side view)

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[2] The standard Boerner sampler used for reducing the size of brown rice samples is described in the following publication: BOERNER, E. G. A DEVICE FOR SAMPLING GRAIN, SEEDS, AND OTHER MATERIAL. U. S. Dept. Agr. Bul. 287, 4 p., illus. 1915.

The modified Boerner sampler used for reducing the size of rough rice samples is described in the following publication: BOERNER, E. G., and ROPES, E. H. A MODIFIFD BOERNER SAMPLER. U. S. Dept. Agr. Bul. 857, 8 p., illus. 1920.

The entire sample is put through the Boerner sampler and is thus repeatedly split down until the quantity required for a scouring test is obtained.

SETTING OF PESTLES

The device is equipped with a large and a small mortar and pestle. The large mortar and pestle are used for scouring large samples. When scouring brown rice the clearance between the pestle and the mortar should be three-eighths of an inch; when scouring rough rice the clearance should be one-half inch. The small mortar and pestle are used for scouring small samples and a clearance of one-fourth of an inch is recommended.

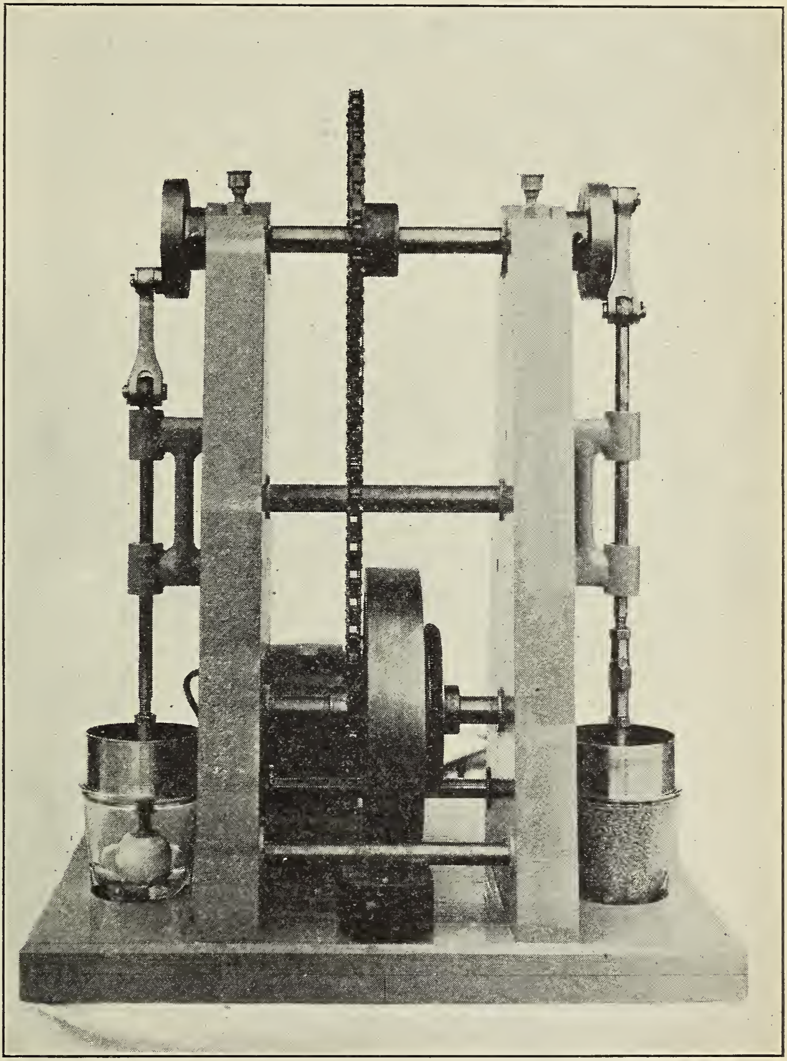

FIGURE 3.—Gehl laboratory rice-scouring device (end view)

The desired clearance can be obtained by placing a shim of suitable thickness under the mortar. The pestle is adjusted so that, at the end of the down stroke, it just touches the bottom of the inside of mortar. The pestle is then fixed in position by means of a lock nut. The shim under the mortar is removed and when the mortar is placed in its regular position the required clearance is obtained.

The large mortar and pestle are used in scouring large portions weighing up to 270 grams of commercial brown rice; the small mortar and pestle are used in scouring small portions of brown rice like those resulting from a "shelling" in the Smith shelling device of a 50-gram portion of rough rice. The mortars and pestles can be interchanged quickly so that the device can be easily prepared to scour either a large or a small sample.

SCOURING BROWN RICE

The device was designed primarily for scouring samples of brown rice obtained from samples of rough rice from which the hulls have been removed by means of the Smith shelling device.

When a portion of brown rice is ready for scouring it is mixed with an equal quantity, by weight, of sharp white silicon sand and the mixture is placed in the proper mortar. The mortar is placed in position in the device and the motor is started. The test may be allowed to run for any designated period of time or the operator may watch the sample as it is being scoured and stop the machine, when in his judgment, the rice has been sufficiently milled. The recommended time for the scouring process for each sample is 15 minutes, with a change of sand every 5 minutes.

A No. 20-mesh wire sieve is recommended for separating the sand, bran, and the fine material removed from the rice during the scouring process, from the rice kernels. By placing the contents of the mortar on the sieve and shaking it the separation is quickly effected, for the sand, small bran particles, and other fine material pass readily through the sieve whereas the whole rice and broken particles of kernels remain on the sieve.

The scoured rice, from which the sand, bran, and fine material has been removed, is then examined for discolored, damaged, and chalky kernels. It is now comparatively easy to determine the color and general appearance of the rice as a whole and to identify kernels that are chalky, pecky, spotted, lightly stained, or slightly heat-damaged, in addition to those that are badly discolored and severely damaged as a result of pronounced heating. The chalky and the damaged kernels are then picked from the sample and weighed or counted and the percentage by weight or number is determined.

SCOURING ROUGH RICE

When a Smith shelling device is not available for removing the hulls from rough rice the scouring device has, under favorable conditions, been used successfully for scouring samples of rough rice direct. For successfully scouring rough rice direct the rice should be dry and should not be of inferior milling quality such as results from overripeness or from extreme softness due to high moisture content. For scouring samples of damp rough rice the rice should first be shelled and then scoured as brown rice or it should be permitted to dry in the laboratory for a few days until the moisture content is sufficiently reduced to permit direct scouring.

A 300-gram portion of rough rice should be used. The rice should be cleaned of foreign materials as thoroughly as possible. If mud lumps remain in the rice while it is being scoured they rub against and discolor the scoured kernels, and certain weed seeds and straws, if present in excessive quantities, tend to cause a jamming of the rice in the mortar which may interfere with its proper movement as it is being acted upon by the pestle. The rice can be readily cleaned by using a No. 12 and a No. 6½ sieve. Such foreign materials as remain in the sample after sieving, can be easily removed by hand picking.

As rough rice offers some resistance to the action of the pestle, particularly when the hulls first begin to separate from the kernels, the rice is fed into the mortar after the pestle is in motion. The large mortar and pestle should be used and the rice poured in gradually so that it does not decrease the rate of speed at which the pestle is moving. If this is not done, the hulls may build up sufficient resistance to stop the motor or to strain the mechanism of the scouring device. The hulls of the rough rice serve as an abrasive; therefore sand is not used.

After the rough rice has been scoured for 15 minutes, the motor is stopped and the rice is removed from the mortar

After the sample has been scoured the rice is cleaned by sieving it with a No. 20-mesh wire sieve to separate the more finely pulverized material. The larger pieces of hulls can then be separated by passing the rice through a Bates laboratory aspirator.[3]

If the first scouring does not remove all of the bran, a second scouring should be given by placing the cleaned rice and an equal quantity by weight of sharp white silicon sand in the mortar.

CONSTRUCTION SPECIFICATIONS

The framework of the device consists of two cast-iron stands held apart by four spacing rods. The stands are of cast-iron channel construction with inside flush and a split bearing on top. They measure 23 inches from the base to the center of the top bearing. The bottom of the stand is 12 inches in length and tapers to 6 inches at the top. The width is 2 inches. The bottom web is one-half of an inch thick, the side webs three-eighths of an inch thick. The crankshaft bearings are in halves and are a part of the stands. A journal cap is provided for the top, and both surfaces of the crankshaft bearings are babbitted. These bearing are 2¼ inches wide to provide liberal bearing surface. Lubrication is accomplished by means of a grease cup. (Figs. 4 and 5.)

On the sides of each of the stands four pads 1½ inches in diameter are cast for the spacing rods and are machined on both sides to project one-eighth of an inch. On the outside of the stands, 10¼ inches from the base, is a pad 6¼ inches in length, 4¼ inches wide, machined to project one-eighth of an inch, which provides a finished surface for mounting the guide brackets. The guide brackets are bolted to the outside of the stands. The stands and guide brackets are of cast iron and the construction is such as to furnish vertical stability to the pestle rod and insure against bending. There are two guides to each bracket. They are connected by means of a vertical rod all being cast integral with the bracket. The guides project from the side of the stands 3¾ inches to the center of the guide, which is 1¼ inches outside diameter by 1¾ inches long. The guides proper are fitted with self-lubricating metaline bushings. The bracket is provided with a top and bottom pad for belting to the side

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[3] BATES, E. N., and BODNAR, G. P. THE BATES LABORATORY ASPIRATOR. U. S. Dept. Agr. Circ. 9, 12 p., illus. 1927.

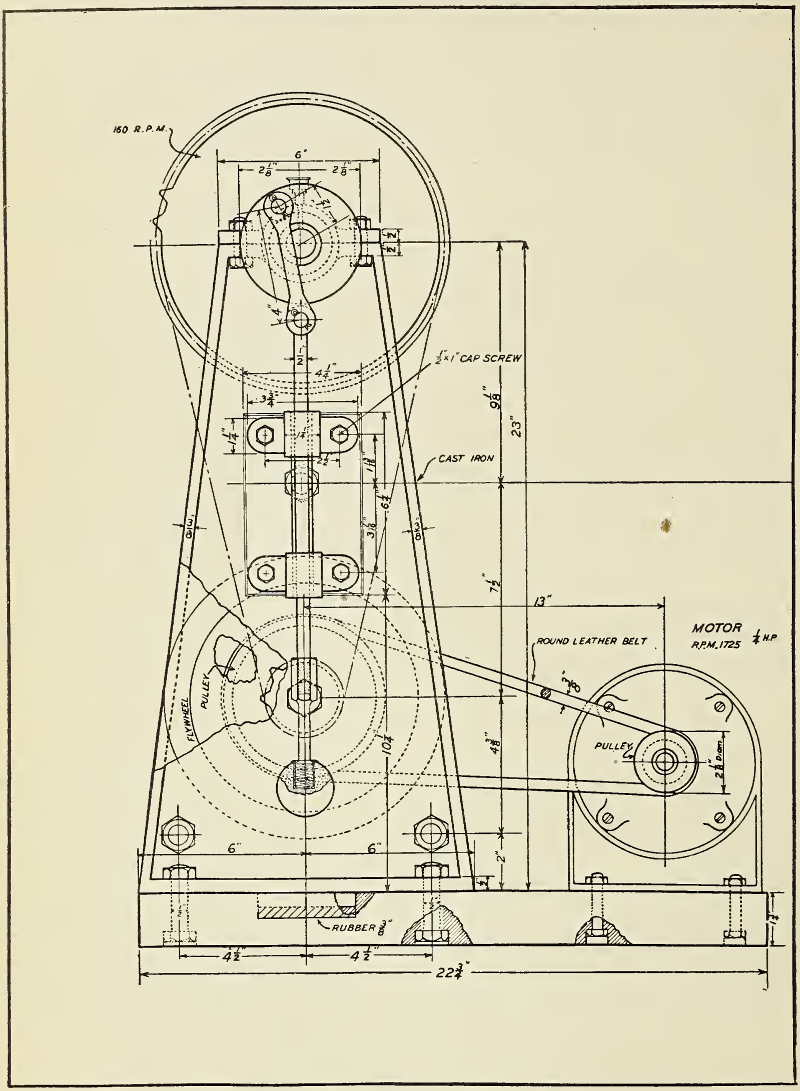

FIGURE 4.—Detailed construction of Gehl laboratory rice-scouring device (side view)

of the stand and it is held in position by means of four one-half inch by 1-inch cap screws which screw into the stand. The spacing of the stands is arranged so that the distance between their inner finished surfaces when mounted is 8 inches. This is accomplished by the use of four spreader or stay rods made of cold-rolled steel.

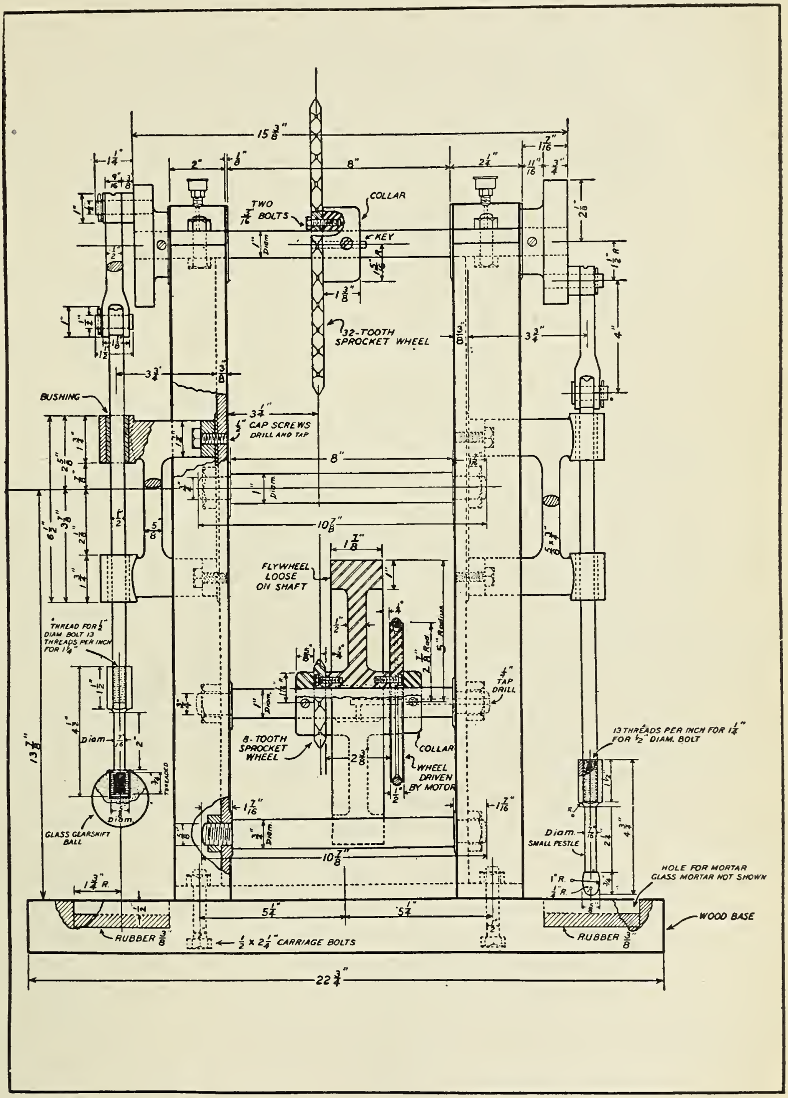

FIGURE 5.—Detailed construction of Gehl laboratory rice-scouring device (end view)

Two rods that connect the bottom part of the stands are located 2 inches from the base. The bottom rods are 10⅞ inches over all and three-fourths of an inch in diameter with machined ends five-eighths of an inch by $1\frac{7}{16}$ inches long to provide a shoulder. The machined ends are threaded for ⅝-inch nuts. A center stay rod is

1 inch in diameter, 10⅞ inches over-all length with the ends similarly turned to three-fourths of an inch to provide a shoulder and threaded for 1$\frac{7}{16}$ inches for ¾-inch nuts. A top stay-rod is 1 inch in diameter, 10⅞ inches over-all length, with the ends likewise turned to three-fourths of an inch so as to provide a shoulder and threaded for 1$\frac{7}{16}$ inches for ¾-inch nuts.

A flywheel of cast iron 10-inch finished diameter with rim 1⅞ inches wide by 1 inch thick is mounted on the center stay rod. The flywheel has a ½-inch web, and a hub 2⅛ inches in diameter by 2⅜ inches in width. The hub is bronze bushed and counterbored to provide a reservoir for lubrication. The flywheel bushing is drilled so that the lubricant in the reservoir may reach the bearing surface. A hole drilled through the center of the flywheel shaft to which a grease cup is attached and connecting with the reservoir in the flywheel provides a means of introducing the lubricant therein. The flywheel pulley is of cast iron 5¾ inches outside diameter, one-half inch thick, grooved for a ⅜-inch round belt. The pulley is attached to one side of the flywheel with countersunk machine screws. A sprocket 2.88 inches outside diameter with eight teeth of 1-inch pitch, five-sixteenths of an inch in width is attached to the other side of the flywheel by means of countersunk machine screws. The flywheel is held in position on the shaft by means of 1-inch steel collars set with headless set screws.

A crankshaft on the top of the stands is 1 inch in diameter by 15⅜ inches over-all length, with crank disks on both ends. The crank disks are made of cast iron and are 4¼ inches in diameter and three-fourths of an inch thick, with an $\frac{11}{16}$-inch hub. These are keyed to the crankshaft with ¼-inch standard keys and headless set screws. The crank pins are one-half of an inch in diameter, projecting from sides of crank disk 1¼ inches, allowing a three-eighths of an inch by 1 inch shoulder on the disk. They are placed 180° apart. They are fitted in the crank with snug fit and riveted flush on the opposite end. The throw of the cranks is 3 inches. The connecting rods are of bronze, with a shank one-half of an inch in diameter, having an eye on one end and a clevis drilled for a ½-inch connecting-rod pin on the opposite end. The connecting-rod pin is of steel, one-half of an inch by 1½ inches, with a one-eighth by five-eighths of an inch flat head and is drilled for a $\frac{1}{16}$-inch counterpin on the opposite end. The pestle rods are made of ½-inch round cold-rolled steel 12½ inches long from center of eye to end of rod, threaded on end for 2 inches with a right-hand ½-inch thread. A sprocket fastened on the crankshaft is 10.52 inches outside diameter, has 32 teeth, 1-inch pitch, is five-sixteenths of an inch in width, and fitted with a hub 1⅜ by 2⅝ inches in diameter, and is attached to the shaft by means of a ¼-inch standard key and a headless set screw. A sprocket chain which passes over the sprockets on the flywheel and crankshaft is standard 1-inch pitch by five-sixteenths of an inch block chain, 56 inches long, connected with detachable connecting link.

The framework of the device is mounted on a wooden base. Each stand is attached to the base by means of two ½-inch by 2¼-inch carriage bolts, countersunk underneath. The wooden base is of 2-ply construction to insure against warping. It is made of four oak boards each 22¾ inches long, 11⅜ inches wide, and seven-eighths of an inch thick. The two boards used for the upper side of the base are set at right angles to the boards on the lower side. The boards composing the lower half of the base are firmly attached to the upper boards by means of suitable wood screws which are screwed in from the bottom and countersunk. This makes a solid warp-proof base 22¾ inches square and 1¾ inches thick. Two depressions are provided in the wooden base to accommodate and center the mortars when these are placed in position. These depressions are so located that the centers of the pestle rods and the centers of the depressions coincide when the device is assembled. They are circular in shape and have a diameter of 3½ inches, a depth of seven-eighths of an inch, and are fitted at the bottom with a gum rubber cushion three-eighths of an inch thick.

The foregoing dimensions will accommodate the base of the large mortar. To center the small mortar the diameter of the depression should be reduced one-half of an inch. This can be accomplished by providing a wooden reduction ring having an inside diameter of 3 inches.

Two detachable pestles are provided for each rod. The small pestles are made from ⅞-inch hexagon cold-rolled steel. This pestle, which is used in connection with the small mortar, is 4¾ inches over-all length with a shank 2¼ inches by seven-sixteenths of an inch in diameter, and an egg-shaped casehardened end five-eighths of an inch in diameter. The upper portion of the pestle is left with hexagon shape for 1½ inches and drilled and tapped for ½-inch right-hand thread to a depth of 1¼ inches. The metal part of the large pestle is 4½ inches over-all length with a 2-inch by $\frac{7}{16}$-inch shank. The end is five-eighths of an inch in diameter, threaded 18 threads per inch for three-fourths of an inch. To this threaded end is attached a glass automobile gear-shift ball 2 inches in diameter. The opposite end is left hexagon for 1½ inches and drilled and tapped for a ½-inch right-hand thread to a depth of 1¼ inches.

The pestles are held in position by screwing them on to the threaded end of the pestle rod. A lock nut is provided on each pestle rod so that when the setting of the pestle has been properly adjusted by screwing it up or down on the pestle rod, it may be firmly fixed in position by means of the lock nut.

Standard glass mixing bowls of 2-cup capacity are used for the large mortars. These should be fitted with detachable brass rims 2 inches high to provide greater capacity and keep the rice from working over the side of the mortar when it is being scoured. The bowls commonly used are standard stock glassware and are usually obtainable at any 5 and 10 cents store. Standard 5¾-ounce parfait glasses are used for all the small mortars. These can be obtained from dealers in soda-fountain supplies.

A motor which drives the mechanism of the scouring device is of one-fourth horsepower having a speed of 1,725 revolutions per minute. The motor pulley is of steel 2 inches in pitch diameter with V-type groove for ⅜-inch round leather belt. The motor pulley is connected to the proper flywheel pulley by means of a piece of ⅜-inch round leather belt 40 inches long.

By means of the pulleys and sprockets the speed reduction necessary to operate the pestles at a rate of 160 strokes per minute is obtained. The electrical control is accomplished by means of an 8-ampere breaker switch, which provides a safety factor in case of a jamming or stopping of the mechanism. The necessary wiring for connecting the motor and electric switch can be concealed by countersinking a groove on the bottom of the base to accommodate the wiring.

The Gehl laboratory rice scourer is built commercially and can be purchased complete. The names and addresses of firms prepared to build the device may be had on application to the Bureau of Agricultural Economics, United States Department of Agriculture.

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